

47.7 J. C. Trautwine, jr.

DEC 15 1899

NATURAL
VENTILATION.



NATURAL VENTILATION.

“We have always maintained that a system of ventilation which could be universally applied must be of such a nature that it cannot get out of order, is independent of any special attention, and is self-acting in every part.”—*Engineering*.

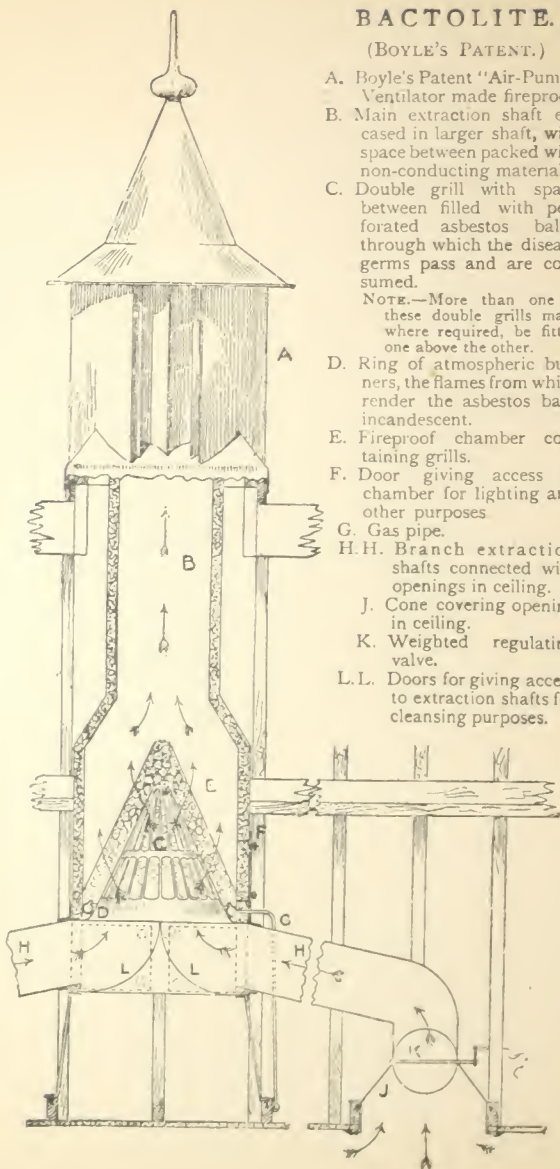
BACTOLITE.

(BOYLE'S PATENT.)

- A. Boyle's Patent "Air-Pump" Ventilator made fireproof.
- B. Main extraction shaft enclosed in larger shaft, with space between packed with non-conducting material.
- C. Double grill with space between filled with perforated asbestos balls, through which the disease germs pass and are consumed.

NOTE.—More than one of these double grills may, where required, be fitted one above the other.

- D. Ring of atmospheric burners, the flames from which render the asbestos balls incandescent.
- E. Fireproof chamber containing grills.
- F. Door giving access to chamber for lighting and other purposes.
- G. Gas pipe.
- H. H. Branch extraction shafts connected with openings in ceiling.
- J. Cone covering opening in ceiling.
- K. Weighted regulating valve.
- L. L. Doors for giving access to extraction shafts for cleansing purposes.



NATURAL VENTILATION.

Reprinted from

"THE BUILDING NEWS,"

MAY 26TH, 1899.



“THERE is, perhaps, no subject which is of greater importance, so far as health is concerned, than that of ventilation, and it is one in which we have all a very strong personal interest. Parkes says: ‘Health is only possible when to other conditions is added that of a proper supply of pure air. Statistical inquiries prove beyond a doubt that of the causes of death which are usually in action, impurity of the air is the most important.’ Another authority says: ‘Anything which has passed through the human body ought to be treated as excreta and rejected;—just as sewage was thrown away into the drains, so air that had passed through the human lungs should

421 8511 B-0601

be got rid of at the earliest possible moment without allowing it to go through the lungs of someone else. It was as unreasonable to breathe the same air twice, or twelve or twenty times over, as was the case in many places, as it would be to go to the sewer for drinking water.'

Destruction of Disease Germs.

"No one has done more for the cause of practical ventilation than Mr. Robert Boyle, who has recently added another important appliance for the preservation of health to the already long list of the well-known sanitary inventions devised by him.

"This appliance, which Mr. Boyle has named 'Bactolite,' is intended to be employed in small-pox and other infectious-diseases hospitals. The accompanying diagram shows the method of destroying the disease germs contained in the air of a hospital, as it passes, or rather is drawn, through an asbestos furnace situated in the roof, and connected with an 'air-pump' ventilator, effectually consuming the poisonous germs, and preventing them from passing into and contaminating the outer air and spreading infection.

"With the 'Boyle' system of ventilation, as applied to small-pox hospitals, the air inlets

communicate direct with the external air through specially-constructed openings made in the walls, fitted with self-acting valves to prevent the air of the hospital passing by any chance out through these openings. The incoming air is warmed in cold weather to an agreeable and healthy temperature by means of Boyle's ventilating radiators, without the deterioration and discomfort which result from hot-air heating.

Air Screens.

"In warm weather, the fresh-air supply is cooled in its passage through adjustable refrigerating chambers attached to the radiators, and is washed and purified by filtration through saturated and medicated screens. The outlets and inlets are accessible in all parts for cleansing purposes. It would appear, from the tests which have been made by scientific experts, that air-screens are more effective when the air is drawn through at a low velocity by natural extraction than with mechanical propulsion. Sir Douglas Galton says: 'If air is forced rapidly through a screen, it cannot fail to carry dust with it.'

"Important features in the system under review are (1) the fresh air is brought directly into the room from the external air, there being no long, tortuous, and inaccessible channels to harbour dust

and dirt ; (2) the air supply not being over-heated, its health-sustaining properties are unimpaired.

Unhealthiness of Hot Air Heating.

“When a building is ventilated with hot air, which also constitutes the means of heating, to satisfactorily effect the latter it is necessary to raise the air to such a high temperature that the oxygen is partially destroyed and its life-giving qualities considerably reduced. There is also experienced with this method a feeling of closeness or want of freshness, even though the air is being rapidly changed.

“Professor Corfield says : ‘Heating should be done by means of radiant heat, and not by means of air previously warmed. If air was previously warmed it would lose a portion of its oxygen, and if we get air short of oxygen we had to breathe a greater number of times to supply the required amount, and that meant more effort.’

“Sir Douglas Galton states that ‘the method of warming the walls by means of heated air necessarily leaves the walls colder than the air of the room, and the heat of the body is radiated to the colder walls. Hence, if the walls are to be warmed by the air admitted to the room, the tem-

perature of the warmed air must be raised beyond what is either comfortable or healthy for breathing, and thus, if you obtain your heat by warmed air alone, discomfort in one form or the other can with difficulty be avoided.'

Hot Air Heating being Discarded.

"This method of ventilating and warming buildings by hot air is now gradually being discarded, as the objections to it are becoming more fully recognised. With respect to this change, Professor R. H. Smith says: 'A most instructive historical fact is the present gradual abandonment in the States and Canada of the hot-air system of house-warming, which was for so long popular, in favour of hot-water pipe and other "radiator" warming. It is, in fact, impossible that the human body should absorb heat from the air in which it is immersed if that air be not made oppressively hot.'

"What is understood by many people as constituting the 'natural' system of ventilation is simply an open window and nothing more, and it is safe to say that there are but few who have not had some experience of the evils arising from that mode of changing the air in cold weather, however useful it may be in warm. 'Natural' ventilation in

that form is, as a consequence, very generally condemned.

Defects of Open Window and Open Fire Ventilation.

“In connection with this, Dr. John Hayward says: ‘Hospitals warmed only by open fires are sure to be very imperfectly warmed; and if at the same time they are attempted to be ventilated only by open windows, they are most certainly also very imperfectly ventilated. In spring and autumn the weather is then generally too cold to have the windows always open, and yet not cold enough to have the fires continually burning, so that the abstraction cannot then be accomplished efficiently by either windows or fires.’ In a Blue Book, issued in 1898, ‘On the Ventilation and Warming of Board Schools,’ on page 23 occurs this statement in reference to ventilation by open windows: ‘In those cases in which the ventilation was effective the temperature of the dormitory would follow closely that of the outside air, and would not exceed that of the outside by more than about $2\frac{1}{2}^{\circ}$.’ That is to say that with open window ventilation with the outside temperature 30° , the inside temperature would practically be the same, plus the inevitable cold draught.

"Misleading and obviously unfair to

Natural Ventilation."

"This somewhat primitive form of ventilation should not, however, be confounded with a natural system of ventilation scientifically arranged to secure a continuous and imperceptible change of air at all times and in all seasons. Where comparative tests have been made with natural and artificial ventilation, open windows generally constituted the 'natural' plan; but as open windows are really no system at all, such tests can only be misleading, and are obviously unfair to natural ventilation correctly applied.

When Natural Ventilation Fails.

"It must be admitted that the reputation of natural ventilation has also suffered a good deal from the abortive attempts of individuals having little or no acquaintance with either the science or the practice of ventilation, and by the employment of so-called ventilating apparatus of crude and unscientific construction. The selection of ventilators is likewise sometimes left by an architect to the contractor, who naturally supplies those upon

which he gets the largest profit, without troubling himself about their efficiency. Parkes says: 'Ventilation is a science, and it requires the study of a lifetime to master properly all its intricacies,' whilst De Chaumont pronounces it to be 'essential to the success of a natural system of ventilation, that both the outlet and inlet ventilators be of correct construction and skilfully applied. Where this is not observed, failure generally ensues with this form of ventilation.'

*Natural Ventilation the method approved
by the Government Commissioners.*

"It is now becoming more generally recognised that natural ventilation, when correctly applied, is found to satisfactorily fulfil all requirements, and the leading authorities are practically unanimous in their approval of that method. Natural ventilation on the upward principle, or top extraction, is the plan recommended by the Government commissioners in a recent Blue Book; downward ventilation, or extraction at the bottom, being condemned. 'Whilst the air is in the lungs,' say the commissioners, 'it acquires so much heat that it becomes specifically lighter than the surrounding air, and rises above our heads. The heated air which passes upwards should pass away. . . .

For the ventilation of rooms exits should be provided for the spent air near the ceiling. . . . The method of low ventilation (extraction near the floor) should be avoided on various grounds.'

Updraught or Downdraught Ventilation?

"Professor Smith, in a recent article in the *Engineer*, deals with the respective merits of upward and downward ventilation very exhaustively, and demonstrates the superiority of the upward method. 'It is clear,' says Professor Smith, 'that the down system can never supply really pure air to be breathed by the lungs. The exhalations of the human body are, as they issue, so warm that they must perforce immediately rise. Therefore, if the supply of fresh air comes from above, it can only reach the nose and mouth by driving down with it, and mixing with, these foul exhalations, and there is unquestionably nothing to breathe except this polluted mixture. In order to keep down the percentage of pollution to a non-dangerous degree, under this system arises, therefore, the necessity of admitting for ventilation fresh air in quantities many times greater than that actually used for breathing, and also a correspondingly extravagant expenditure of heat if this supply be artificially warmed. Thus the only ideally perfect

ventilation consists in inducing a regular up-current from a level below that of the human head up to the extraction outlets at the ceiling. Under this system the bulk of fresh air required to be admitted is immensely reduced, as is also the expense of warming it to any degree considered desirable.'

Why Updraught Ventilation is preferable.

"In the report submitted to the United States Congress by the Commission on Ventilation, the following occurs:—

"‘The direction of the currents of air from the human body is, under ordinary conditions, upwards, owing to the heat of the body. This current is an assistance to upward and an obstacle to downward ventilation. In large rooms, an enormous quantity of air must be introduced in the downward method, or about three times the amount which is found to give satisfactory results with the upward method. For these and other reasons the Board are of opinion that the upward method should be preferred.’

Evils of Downdraught Ventilation.

"Dr. John Hayward, who is one of the highest authorities on the question, says that: ‘To

the plan of abstracting the foul air near the floor there are at least four grave objections: (1) It is opposed to Nature's law of atmospheric pressure, and therefore requires the use of special abstracting power by means of furnaces for its accomplishment; (2) by drawing down the foul air it causes it to be breathed over again, which recently-breathed air ought never to be; (3) the fresh air supplied is apt to be forced in over-heated—in fact, burned—and so made unhealthy: (4) the long, tortuous flues cannot be kept clean, and will, therefore, become lurking-places for dust and germs. The plan is quite unsuitable for hospitals, and should certainly never be used where there is likely to be infection.' Another authority denounces this method as 'a standing menace to the health of society,' and says that the dangers of it 'cannot be exaggerated.'

"Powerful Natural Forces."

"Dr. Parkes, in 'A Manual of Hygiene,' recommends natural ventilation as the best for this climate, and that 'for hospitals natural ventilation certainly seems the proper plan.' He further says, 'Incessant movement of the air is a law of Nature; we have only to allow the air in our cities and dwellings to take share in this constant change, and ventilation will go on uninterruptedly without our care. In this country,

and, indeed, in most countries, even comparative quiescence of the air for more than a few hours is scarcely known. Air is called 'still' when it is really moving 1 or $1\frac{1}{2}$ miles an hour. Advantage, therefore, can be taken of this aspirating power of the wind to cause a movement of the air up a tube.'

"Dr. Hayward also testifies to the existence of these powerful natural forces which may be utilised for ventilation. 'If, therefore,' says Dr. Hayward, 'the inlets and outlets be properly proportioned and open, the ordinary atmospheric pressure will carry on the ventilation quite efficiently, and the whole hospital will be kept fresh and comfortable by the natural forces alone. There is no fear that the speed will not be enough to keep up efficient ventilator—it is more likely to be too great; but there need be no fear of its being too great, because it is completely under control, and can be regulated to any rate desired by the valves at the ward inlets and outlets. Natural ventilation is certainly much to be preferred to any and every artificial system, whether on the plenum or vacuum principle, and it is, of course, much less complicated. It is, indeed, comparative simplicity itself—merely arranging openings and warming the air, and, as shown above, it acts more than efficiently. It also involves very little original outlay, and comparatively no permanent cost for

maintenance. Whereas all artificial systems involve costly original plant of machinery, as well as heavy permanent expense for maintenance in engines, engineers, fuel, &c., and with all they cannot be made as efficient or nearly so pleasant and healthy in operation.'

Natural v. Mechanical Ventilation.

"At the Public Health Congress held in London, there seemed to be a consensus of opinion in favour of natural methods of ventilation in preference to artificial, as also at the Congress of the Sanitary Institute held at Liverpool, one of the speakers, Surgeon-General Sir Thomas Crawford, saying: 'My experience of the process of forcing air into buildings is not in its favour. The only safe and sound means for the supplying of air is the natural one of obtaining it from a pure source in a free and natural flow.'

"Professor Wade, as the result of his experience of both methods, arrives at the conclusion that 'ventilation can only be successfully accomplished at all times when it is effected without assistance from mechanical or artificial contrivances. However perfect these may appear, they can never achieve results superior to those

insured by judicious and intelligent adaptation of natural means, and they necessarily suffer from the very serious disadvantage that they are liable to interruption without warning, and with possibly disastrous consequences.'

"Mr. G. H. Bibby, F.R.I.B.A., the author of several well-known works on the sanitary construction of buildings, expresses the views of an architect, who is also an expert, on the subject. 'Perfect ventilation,' says Mr. Bibby, 'may be obtained without liability to those dangers and difficulties to be met with where a natural system is set aside in favour of exclusively mechanical modes. The expense of mechanical ventilation is unnecessary, for there is sufficient evidence to show that such buildings as asylums, workhouses, and hospitals are best ventilated by natural means, and no architects of great repute or position have of late years relied upon mechanical ventilation.'

*"A Striking Example of the Power of
Natural Ventilation."*

"The ventilation of the small-pox hospital ship *Castalia* by natural means is a striking example of the power of that method when properly applied. Messrs. Robert Boyle and Son, who may be said to be the first to introduce natural ven-

tilation in a scientific form, having been instructed by the Metropolitan Asylums Board to apply their system to the *Castalia*, on the completion of the work the Board instituted a lengthy series of experiments to test its efficiency, with the result that the air-pump ventilators were found to be extracting at the average rate of five million cubic feet of air per hour, changing the air of the wards once every five minutes. On the calmest day and in foggy weather, when the external air seemed to be perfectly still, it was found that a powerful up-draught was always maintained in the shafts, and not the slightest down-draught at any time. There was also, even though the air was being changed so rapidly, an entire absence of draughts in the wards.

“The Most Notable Example Extant of the Efficiency of Natural Ventilation.”

“Perhaps the Long Room of the London Custom House is the most notable example extant of the efficiency of a natural system of ventilation, so many different methods having been previously tried without success, even though such eminent scientists as Professor Faraday and Dr. Ure essayed the task. Her Majesty’s Office of Works finally called in the aid of Messrs. Boyle, who applied their system, with results which are now historic in the annals of ventilation, and which

would seem to justify the opinion expressed in the report on the ventilation that they, 'as founders of the profession of ventilation engineering, have raised the subject to the dignity of a science.'

Fog Entirely Excluded.

"One passage in the report certainly appeals to us poor fog-ridden Londoners, and at the same time shows to what a high state of perfection natural ventilation may be brought. The report says: 'Before Messrs. Boyle's system was applied there used to be a perpetual haze, or cloud, hanging below the ceiling. This has since entirely disappeared. In foretime, when a fog got into the room, it was several days before it got out; now, when a dense fog prevailed outside, the atmosphere of the Long Room remained quite clear, and continued so throughout the day.'

"The Right Honourable C. Seale-Hayne, M.P., speaking recently at a public function, said of the Boyle system of ventilation: 'I believe it to be absolutely the best system of airing a public building that is known to sanitary science.'

The Natural Laws of Ventilation.

"Messrs. Boyle's system is extremely simple, and may be described as the application of means by which the natural laws of ventilation

can be effectively brought into operation, the power which operates in producing the currents being as constant as gravity. Houghton says: 'Science proves that there is not a moment of time but when there is a movement of the air, and this movement properly utilised is sufficient at all times to change the air in a building and secure ventilation.'

"These powerful natural forces are what Messrs. Boyle utilise to the utmost by the scientific arrangement of their system, and the construction of the 'air-pump' ventilator, with respect to the action of which Professor Macquorn Rankin reported, after twelve months' experiment, 'There is no time throughout the whole year but when there is a sufficient movement in the atmosphere to cause the "air-pump" ventilator to act.'

"This report was endorsed by Professor Grant, who stated that the air-pump ventilator was 'constructed on sound scientific principles, acts in strict accordance with the laws of nature, and cannot fail to operate.'

"Messrs. Boyle have, we understand, successfully applied a natural system of ventilation to over one hundred thousand public buildings in various parts of the world, including hospitals, churches, schools, council chambers, &c., in many of which artificial systems had previously been tried without success.

Air Analysis not Conclusive.

“That engine-driving columns of air through a building does not necessarily ventilate it is evidenced by the following extract from a recent report on the ventilation of the Houses of Parliament:—

“ ‘When one considers the enormous volume of air, equal to ten times the cubic contents of the House of Commons, which is passed through it every hour, also that the elaborate tables of air analysis are apparently all that could be desired, and yet the ventilation is so notoriously bad, it is clear that there is something very radically wrong with mechanical ventilation by impulsion, and that tables of analysis and of volumes of air passed through a building are not to be accepted as correctly indicating either the general purity of the air or the efficiency of the ventilation.’ ”

Authorities on Ventilation.

“Such eminent scientists as Lord Kelvin, Lord Clifford (member of the House of Lords Commission on Hospitals), Sir Douglas Galton, F.R.S., Sir Benjamin Ward Richardson, F.R.S., Professor Corfield, Professor Shaw, and amongst architects Sir Arthur Blomfield, A.R.A., Mr. Alfred Waterhouse, R.A., and Professor Geo. Aitchison, R.A.

(President of the Royal Institute of British Architects), testify to the efficiency of natural ventilation as applied by Messrs. Boyle. The system has also been extensively used for railway carriages, and in the leading navies and steamship lines, Sir Hastings Reginald Yelverton, First Sea Lord of the Admiralty, reporting most favourably upon it; while Dr. Nansen has expressed his high opinion of it as supplied to the *Fram*. It was adjudged the best and awarded the prize at the International Ventilation Competition, opened in London by H.R.H. the Duke of Edinburgh, when all the best-known natural and artificial systems of ventilation in use at the time competed."

"A man of indubitable inventive genius, and strong philanthropic zeal."—*Scotsman*.

"BOYLE, the inventor.—From his earliest youth of an inventive turn of mind. . . . As a philanthropist and a lecturer he gained a wide reputation, but it is as an inventor of sanitary appliances that his name will always be most associated. . . . The result being the now famous 'air-pump' ventilator, which is so widely used not only in this but in other countries."—*Liverpool Courier*.

"ROBERT BOYLE bore a distinguished name in science and proved himself worthy of it. He is now best and most widely known through his 'air-pump' ventilator, which has been applied with signal success to many of our public buildings."—*Edinburgh Courant*.

"Had Mr. BOYLE distinguished himself by nothing but the invention of the 'air-pump' ventilator, he would have well deserved to have a memorial of his career placed before the public. . . . The son inherits the ability and character of his father, and is highly esteemed for his scientific attainments, his literary power, and his influential position as the head of a large and important industry."—*British Mail*.

"A sketch—rather too brief—of the lives of ROBERT BOYLE, father and son, who have brought the question of ventilation and sanitation to a science by the discoveries of their inventive genius."—*Christian World*.

"A bright story of true Christian heroism. As we read through these pages of the almost insurmountable difficulties overcome by the BOYLES, father and son; of the good done; the sanitation achieved; the inventions perfected; we see men whose sole aim was to serve God, benefit mankind, and whose example should be held up to all our boys beginning life."—*Christian*.

"An excellently written biography of the eminent inventor and philanthropist, ROBERT BOYLE. . . . The work is practically a biography of the late ROBERT BOYLE and of his son ROBERT, who is still living and carrying on his father's great work as a sanitary engineer. Both are characters such as Samuel Smiles might well apply his genius to describing."—*Hull Express*.

LONDON: ROBERT BOYLE & SON, LTD.,

64, HOLBORN VIADUCT.

AND AT GLASGOW, PARIS, BERLIN, AND NEW YORK.

MR. ROBERT BOYLE'S
 "SANITARY CRUSADES."

2s. EACH, ILLUSTRATED.

A Sanitary Crusade through the Continent
 of America.

A Sanitary Crusade through the Far East
 (India, China, Corea, Japan).

A Sanitary Crusade through South Africa.

A Sanitary Crusade through Australasia, Poly-
 nesia, Java, Borneo, Sumatra, Malay Peninsula,
 Siam, Burmah.

A Sanitary Crusade through Europe.

A Sanitary Crusade through North Africa
 (Morocco, Algeria, Tunis, Tripoli Egypt, The
 Soudan).

A Sanitary Crusade through Iceland and The
 Faroes.

LONDON: ROBERT BOYLE & SON, LTD.,
 64, HOLBORN VIADUCT.

AND AT GLASGOW, PARIS, BERLIN, AND NEW YORK

Printers: SIR JOSEPH CAUSTON & SONS, Limited, London.





